

## Earth's Atmosphere

### ES-4 The student will demonstrate an understanding of the dynamics of Earth's atmosphere.

#### ES-4.8 Predict weather conditions and storms (including thunderstorms, hurricanes, and tornadoes) on the basis of the relationship among the movement of air masses, high and low pressure systems, and frontal boundaries.

**Taxonomy level:** 2.5-B Understand Conceptual Knowledge

**Previous/future knowledge:** Students in 4<sup>th</sup> grade summarized the conditions and effects of severe weather including thunderstorms, hurricanes, and tornadoes. In 6<sup>th</sup> grade students summarized the relationship of the movement of air masses, high and low pressure systems, and frontal boundaries to storms and other weather conditions. In Earth Science this foundation will be deepened as the complexity of air movement of and within weather systems are studied so that predictions can be made.

**It is essential for students to know** that *weather* is the current, day-to-day, conditions of the atmosphere. Air masses, high and low pressure systems, and frontal boundaries are the major causes of weather variations and storms. Many meteorological processes involve atmospheric movement, such as convection, on different scales. Predicting weather conditions and storms comes from knowing that they are part of and the result of relationships among the following factors in the atmosphere.

*Air masses* Students need to know how an air mass forms, the types of air masses that usually affect North America, and the source regions for these air masses. They should understand that as air masses move their characteristics modify according to the surface(s) over which they travel.

*High pressure system* Students need to know that sinking air is associated with high pressure systems, also called *anticyclones*. With the Coriolis effect, sinking air circulates downward and to the right in the northern hemisphere spreading away from the center when it reaches Earth's surface. High pressure systems rotate clockwise. High pressure systems are usually associated with fair weather and generally pleasant conditions.

*Low pressure system* Students need to know that in surface low pressure systems, also called *cyclones*, air rises. Rising air must be replaced, so the flow of air is inward toward the center and then upward. A low pressure system in the northern hemisphere moves in a counterclockwise direction. Low pressure systems are usually associated with clouds and precipitation.

*Fronts* Students need to know how air masses influence the formation of the four main types of fronts: *cold* front, *warm* front, *occluded* front, and *stationary* front. They need to know the direction of airflow within the frontal region and what factor(s) influences the direction of frontal movement. They need to know the characteristic cloud formations and weather patterns that result from each frontal boundary.

It is also essential for student to know about the factors that influence weather conditions in order to gain an understanding of storms.

- The major storms – thunderstorm, hurricanes, and tornadoes, are associated with low pressure cyclonic movement of air and/or frontal boundaries.
- Students need to know the conditions under which these storms form, how they are related to the factors that influence weather conditions (air masses, pressure systems, and fronts), and also factors concerning their duration and severity.
- Plotting the course of a hurricane and predicting its possible path based on atmospheric conditions is also essential in the study of this storm.

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**It is essential for students to use** weather map data that includes air masses, pressure systems and isobar lines, and fronts (as well as station model data) to predict weather conditions in regions across the United States.

**It is not essential for students to** actually collect weather data using weather instruments (4<sup>th</sup> and 5<sup>th</sup> grade). The reading of radar images or infrared satellite images though interesting is not essential.

### **Assessment Guidelines:**

The objective of this indicator is to *predict* weather conditions and storms; therefore, the primary focus of assessment should be to make logical predictions from presented information, including air masses, high and low pressure systems, and frontal boundaries.

In addition to *predict* appropriate assessments may require students to:

- *summarize* the formation and severity of different storms;
- *compare* high and low pressure systems;
- *compare* the formation and weather conditions of the different fronts;
- *interpret* diagrams or illustrations of air masses, pressure systems, and fronts; or
- *predict* weather conditions from information on a weather map.